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Indian Standard

SPECIFICATION FOR CERAMIC TOWER PACKINGS

(First Revision)

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 1980

AMENDMENT NO. 2 JUNE 2007
TO
IS 7087 : 1979 SPECIFICATION FOR CERAMIC TOWER PACKINGS

(First Revision)

(*Page* 4, *clause* **2.1**, *line* 1) — Substitute 'IS 2781 2004* *for IS* 2781 - 1975*

(*Page* 4, *foofnote marked* *) — Substitute the following for the existing

'*Glossary of terms relating to ceramicware (*second revision*) '

(*Page* 12, *clause* **6.2.1**) — Substitute the following for the existing clause

'**6.2.1** *BIS Certification Mark*

The package may also be marked with the Standard Mark

6.2.1.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act,* 1986 and the Rules and Regulations made thereunder The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards '

(*Page* 13, *Appendix* B, *clause* **B-1.1)** — Substitute 'IS 264 2005*' *for* 'IS 264 - 1976*'

(*Page* 13, *footnote marked* *) — Substitute the following for the existing

*Nitric acid — Specification (*third revision*)'

(*Page* 13, *Appendix* B, *clause* **B-1.2)** — Substitute IS 266 1993†' *for* 'IS 266 - 1977†'

(*Page* 13, *footnote marked* †) — Substitute the following for the existing.

'†Sulphuric acid — Specification (*third revision*) '

(*Page* 15, *Appendix* C, *clause* **C-2.0,** *line* 2) — Substitute 'IS 1070 1992*' *for* 'IS 1070-1977*'

(*Page* 15, *footnot marked* *) — Substitute the following for the existing

*Reagent grade water — Specification (*third revision*) '

(*Page* 15, *Appendex* C-2.3) — Substitute IS 265 1993†' *for* IS 265 - 1976†'

(*Page* 15, *footnote market* †) — Substitute the following for the existing.

'†Hydrochlorid acid — Specification (*forth revision*) '

(*Page* 15, *Appendix* C, *clause* **C-2.4**) — Substitute 'IS 266 1993‡' *for* 'IS 266 - 1977‡ '

(*Page* 15, *footnote marked* ‡) — Substitute the following for the existing

'‡ Sulphuric acid — Specification (*third revision*) '

(*Page* 15, *Appendix* C, *clause* **C-2.6**) — Substitute 'IS 296 1986§' *for* 'IS 296- 1974§'

(*Page* 15, *footnote marked*§) — Substitute the following for the existing

'§Specification for sodium carbonate, anhydrous (*third revision*)'

(*Page* 15, *Appendix* C, *clause* **C-2.7**) — Substitute 'IS 264 2005||' *for* 'IS 264 - 1976||'

(*Page* 15, *footnote marked* ||) — Substitute the following for the existing

'|| Nitric acid — Specification (*third revision*) '

(*Page* 19, *Appendix* E, *clause* **E-2.1**) — Substitute 'IS 266 1993†' *for* 'IS 266 - 1977†'

(*Page* 19, *footnote marked* †) — Substitute the following for the existing

'†Sulphuric acid — Specification (*third revision*)'

(*Page* 19, *Appendix* E, *clause* **E-2.3**) — Substitute 'IS 296 1986‡' *for* IS 296-1974‡

(*Page* 19 *footnote marked*‡) — Substitute the following for the existing

'‡Specification for sodium carbonate anhydrous (*third revision*)

(*Page* 19, *Appendix* E, *clause* **E-2.4**) — Substitute 'IS 265 1993§' *for* IS 265 - 1976§'

(*Page* 19, *footnote marked* §) — Substitute the following for the existing

'§Hydrochlorid acid — Specification (*fourth revision*) '

(CHD 9)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 1 MARCH 2000
TO
IS 7087 : 1979 SPECIFICATION FOR CERAMIC TOWER PACKINGS

(*First Revision*)

(*Page* 9, *clause* **5.6.3,** *line* 2) — Delete the word 'transversely'.

(CHD 9)

Reprography Unit BIS, New Delhi, India

IS : 7087 - 1979

Indian Standard

SPECIFICATION FOR CERAMIC TOWER PACKINGS

(First Revision)

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Indian Standard

SPECIFICATION FOR CERAMIC TOWER PACKINGS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 11 June 1979, after the draft finalized by the Ceramicware Sectional Committee had been approved by the Chemical Division Council.

0.2 This standard was first published in 1973. However, the Committee responsible for its preparation felt the necessity for revising it taking into consideration the recommendations made by consumers and manufacturers of ceramic packings. In this revision, accordingly, besides some other changes, Grade 2 packings with water absorption exceeding one percent by mass have been deleted, and only one grade has now been retained. In addition, values for crushing strength of tower packings of Types 1, 2, 3 and 4 have also been raised keeping in view the investigations carried out by the College of Ceramic Technology, Calcutta and M/s E. I. D-Parry Ltd, Ranipet.

0.3 Vor the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS . 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard prescribes the requirements and methods of sampling and test for ceramic tower packings suitable for use in absorption towers, refining columns, scrubbers, etc, of chemical plants.

---

*Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.1 For the purpose of this standard, definitions given in IS : 2781-1975* shall apply.

3. DESIGNATION

3.1 Ceramic lower packings shall be designated by their type and nominal size with an oblique separating them. For example, a packing of Type 2 and nominal size 100 mm shall be designated as ' 2/100'.

4. TYPES

4.1 There shall be eight types of packings as following'

Type 1 — Cylindrical packings without partition (*see* Fig. 1):

Type 2 — Cylindrical packings with one partition (*see* Fig. 2),

Type 3 — Cylindrical packings with 3 partitions (*see* Fig. 3);

Type 4 — Cylindrical packings with 4 partitions (*see* Fig, 4),

Type 5 — Cylindrical packings with corrugations on outer surface (*see* Fig. in Table 2),

Type 6 — Intalox and Berl Saddles (*see* Fig. in Tables 3A and 3B),

Type 7 — Honeycomb packings with smgle and double units (*see* Fig. 5A and 5B), and

Type 8 — Triangular packings (*see* Fig. 6).

5. REQUIREMENTS

5.1 Description — Ceramic tower packings shall be fired ceramicware with glazed or unglazed surface.

5.2 Forms and Dimensions — Forms and dimensions of ceramic tower packings shall be as follows

a) For Types 1 to 4, as given in Fig. 1 to 4 and Table 1,
b) For Type 5, as given in Table 2,
c) For Type 6, as given in Tables 3A and 3B,
d) For Type 7, as given in Fig. 5A and 5B, and
c) For Type 8, as given in Fig. 6.

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*Glossary of terms relating to coramicware (*first revision*) .

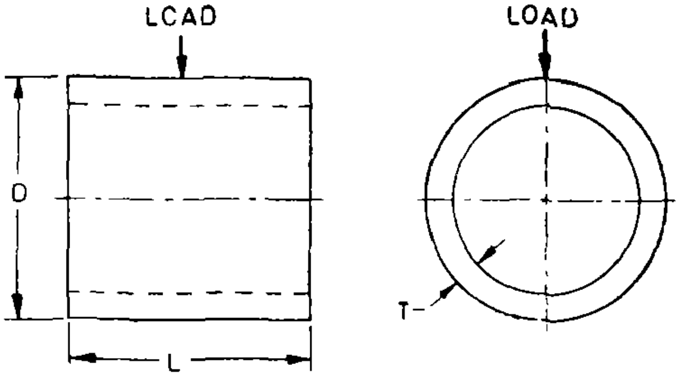


FIG. 1 CYLINBRICAL PACKING WITHOUT PARTITION (TYPE 1)

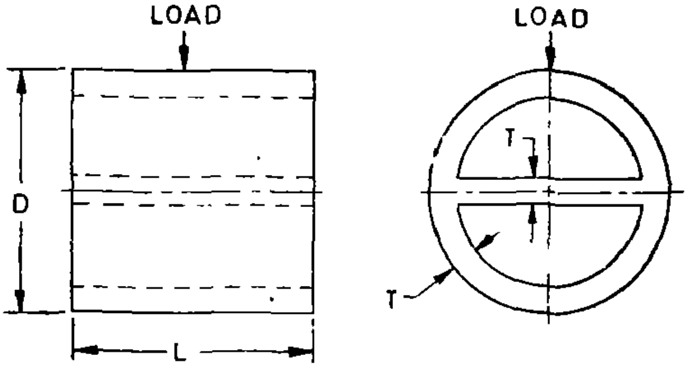


FIG. 2 CYLINDRICAL PACKING WITH 1 PARTITION (TYPE 2)

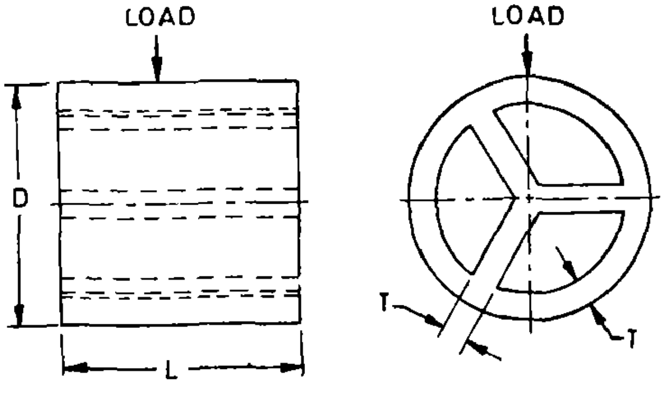


FIG. 3 CYLINDRICAL PACKING WITH 3 PARTITIONS (TYPE 3)

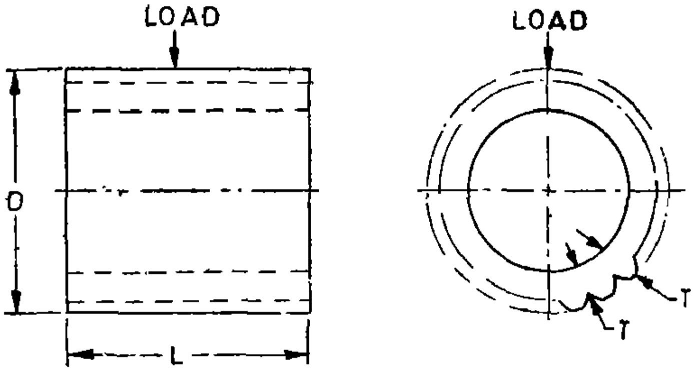
5.3 Water Absorption — The water absorption of the material, when tested in accordance with the method prescribed in Appendix A, shall be not more than one percent by mass.

5.4 Resistance to Acid — The resistance of the material to attack by acid, when tested in accordance with the method prescribed in Appendix B, shall be not less than 99.5 percent by mass.

5.5 Resistance to Arsenical Alkaline Solution — The material shall pass the test for resistance to attack by arsenical alkaline solution, when tested in accordance with the method prescribed in Appendix C.

5.6 Crushing Strength — The material, when tested in accordance with the method prescribed in Appendix D, shall withstand load distributed along an element of the packing as stated below.

TABLE 2 FORM AND DIMENSIONS OF CERAMIC TOWER PACKINGS OF TYPE 5 (CYLINDRICAL PACKINGS WITH CORRUGATIONS)



SL NO (1)	NOMINAL SIZE (2)	DIAMETER AND LENGTH (*D* = *L*) (3)	WALL THICKNESS T (4)	r, (5)	DEPARTURE FROM ROUNDNESS (6)
	mm	mm	mm	mm	mm
i)	50	50 ± 3	5 ± 2	8 ± 2	± 5
ii)	80	80 ± 3	8 ± 2	12 ± 3	± 8
iii)	100	100 ± 3	10 ± 2	15 ± 3	± 10
iv)	120	120 ± 4	11 ± 3	17 ± 4	± 12
v)	150	150 ± 5	12 ± 3	18 ± 4	± 15

5.6.1 *Cylindrical Tower Packings of Types 1, 2, 3, 4 and 5* — The tower packings shall withstand loads, as follows. when applied diametrically (*see* Fig 1, 2, 3 and 4 and Table 2).

Types 1 *and* 5	Not less than 10 kg per linear cm
Type 2	Not less than 12 kg per linear cm
Types 3 *and* 4	Not less than 15 kg per linear cm

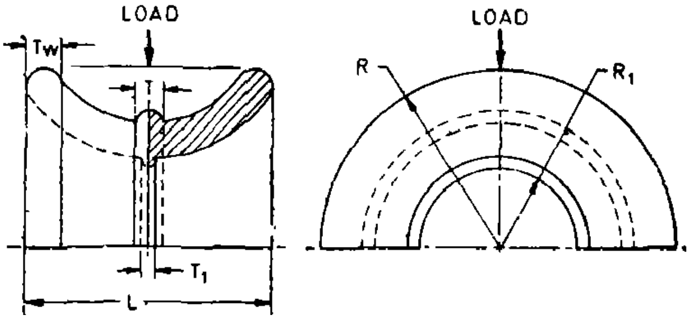
NOTE In the case of partitioned packings, the load shall be applied as above but midway between the partition(s)

5.6.2 *Tower Packings of Type 6* — The material shall withstand loads mentioned below when applied transversely on an element as shown in Table 3A:

Nominal Size mm	*Crushing Strength, Min* kg
20	25
23	50
35	70
50	100

TABLE 3A FORM AND DIMENSIONS OF CERAMIC TOWER PACKINGS OF TYPE 6 (INTALOX SADDLES)

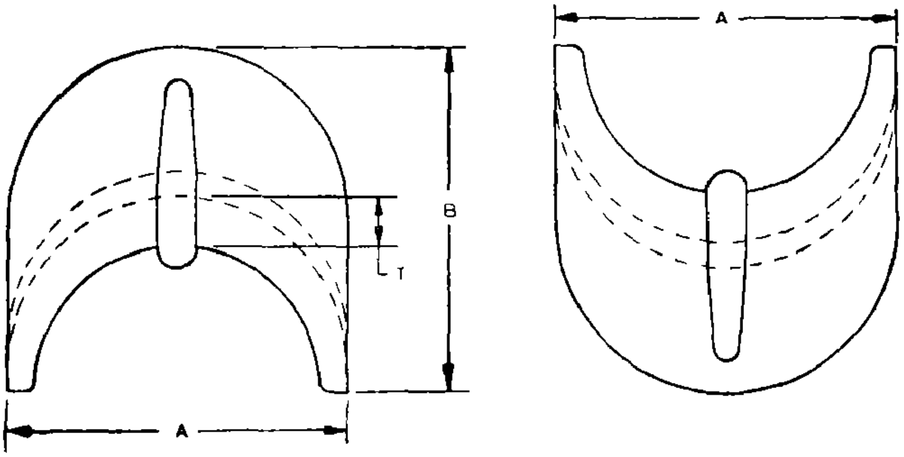
(*Clause* 5 2)



SL No. (1)	NOMINAL SIZE (2) mm	DIMENSION					
		L (3) mm	T_1 (4) mm	T_1 (5) mm	*R* (6) mm	R_1 (7) mm	T_W (8) mm
i)	20	18 ± 1	1 75 ± 0 25	1 75 ± 0 25	13 ± 1	5 25 ± 0 5	2 5 ± 0.25
ii)	2')	24 ± 1	2 5 ± 0 25	2.5 ± 0 25	17 ± 1	7 5 ± 0 5	3.5 ± 0 5
iii)	35	35 ± 1 5	3 5 ± 0 5	1 75 ± 0 25	25 5 ± 1 0	11 ± 1	45 ± 05
iv)	50	47 ± 1 3	5 0 ± 0 5	2 05 ± 0 ???	34 0 ± 1 5	15 ± 1	6 0 ± 0 5

TABLE 3B FORM AND DIMENSIONS OF CERAMIC TOWER PACKINGS OF TYPE 6 (BERL SADDLES)

(*Clause* 5 2)

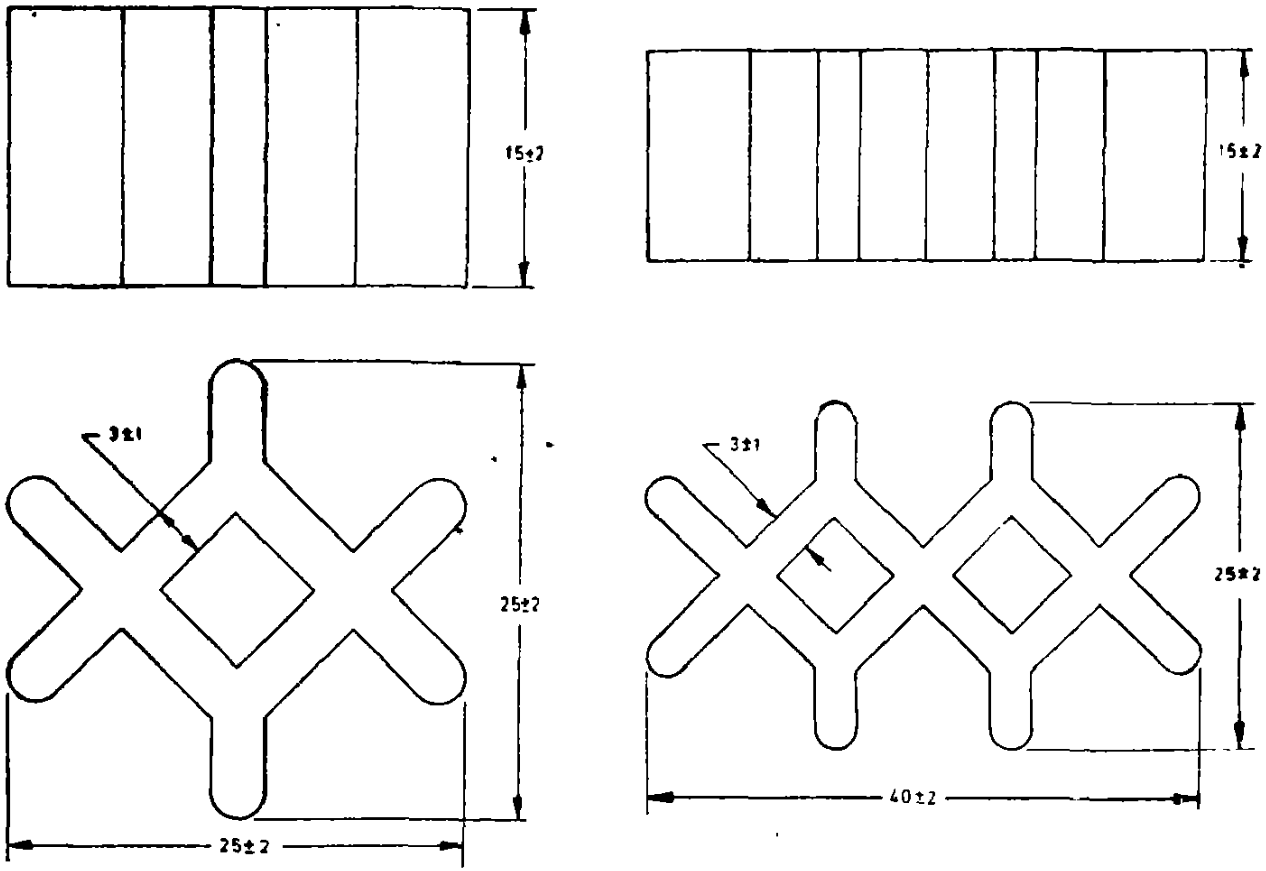


SL No	NOMINAL SIZE	DIMENSIONS			
		A	*B*	T	Tolerance on Dimensions
(1)	(2) mm	(3) mm	(4) mm	(5) mm	(6) percent
i)	20	19	19	4	± 10
ii)	25	25	25	5	± 10
iii)	35	38	38	6	± 5
iv)	50	50	50	7	± 7

5.6.3 *Tower Packings of Types 7 and 8* — The material shall withstand loads mentioned below when applied transversely on an element:

Name of Packing	*Crushing Strength, Min* kg
Single honeycomb	1 500
Double honeycomb	3 500
Triangular	2 000

5.7 Total Iron Content — The total iron content of the material, when tested in accordance with the method prescribed in Appendix E, shall be not more than 1.5 percent by mass.

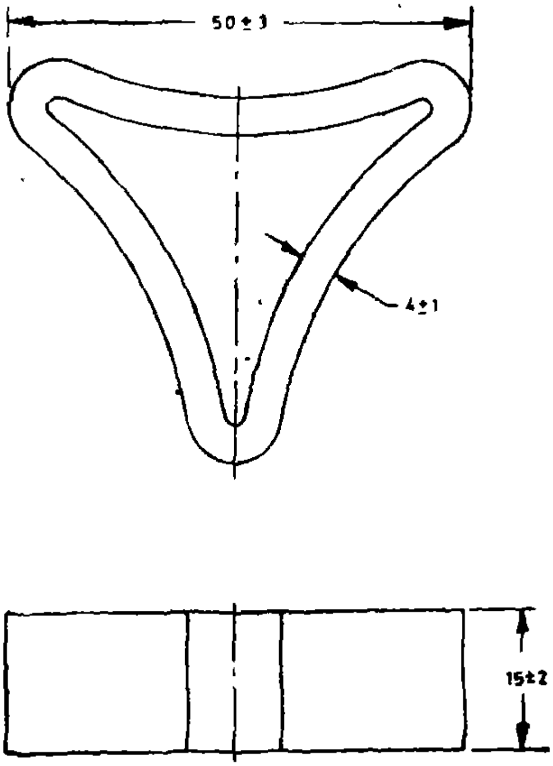


All dimensions in millimetres

FIG. 5A AND 5B HONEYCOMB PACKINGS WITH SINGLE AND DOUBLE UNITS (TYPE 7)

5.8 Permissible Defects — The material shall not have chipped edges deeper than one-fourth of the wall thickness. In respect of other defects, the limits shall not exceed the following:

Nature of Defect	*Limit*
a) Occasional surface blister 1 to 2 mm high	3 in number in a piece
b) Incomplete cracks up to 1 mm wide	3 in number in a piece
c) Cuts up to 0.5 mm wide and not more than 5 mm long	3 in number in a piece



All dimensions in millimetres

FIG. 6 TRIANGULAR PACKING (TYPE 8)

6. PACKING AND MARKING

6.1 Packing — Ceramic tower packings shad be packed as agreed to between the purchaser and the supplier.

6.2 Marking — Each package of the material shall be marked permanently and legibly with the following:

a) Name or recognized trade-mark of the manufacturer, if any,

b) Designation of ceramic tower packing; and

c) Number of pieces in the package.

6.2.1 The package may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI CERTIFICATION Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution

7. SAMPLING

7.1 The method of drawing representative samples of the material and the criteria for conformity to this standard shall be as prescribed in Appendix E.

APPENDIX A

(*Clause* 5.3)

TEST FOR WATER ABSORPTION

A-0. GENERAL

A-0.1 Test pieces shall be taken from the body of the material. They shall be free from sharp comers, friable edges and loose dust. Three pieces or groups of pieces each weighing between 50 and 100 g shall be taken for the test.

A-1. PROCEDURE

A-1.1 Clean the samples and dry to constant mass at 110 to 115°C. Weigh the clean dry samples to the nearest 0.01 g and immerse in boiling water for two hours without permitting them to touch the sides of the vessel. At the end of this period stop heating and leave the the samples to cool in the same water. At the end of 24 hours remove the samples from water, wipe with a wet cloth and reweigh quickly.

A-2. CALCULATION

A-2.1 Calculate water absorption as follows

$$\text{Water absorption, percent by mass} = \frac{(M_1 - M)}{M} \times 100$$

where

M = mass in g of the clean dried sample, and
M_1 = mass in g of the sample after soaking in water.

APPENDIX B

(*Clause* 5.4)

TEST FOR RESISTANCE TO ACID

B-1 REAGENTS

B-1.1 Concentrated Nitric Acid — *See* IS . 264-1976*

B-1.2 Concentrated Sulphuric Acid — *See* IS 266-l977†.

B-1.3 Barium Chloride Solution — 10 percent (*m/v*).

B-2. PREPARATION OF THE TEST SAMPLES

B-2.1 Crush the samples m a, stoneware mortal, sieve and collect not less than 30 g of the fraction which passes through 850-micron IS Sreve but is retained in 600-micron IS Sreve. Wash the collecied fraction free from dust as follows

Place the collected, material in a porcelain basin, add about 150 ml of distilled water for each 30 g of the material. Place the basin on a sandbath and heat to boil. Continue boiling for about

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*Specification for nitric acid (*second revision*).

†Spccification for sulphuric acid (*second revision*).

one hour taking care to avoid any loss by spurting. Decant the water immediately and rinse the particles four times with cold distilled water. Dry the material at 100°C to a constant mass (about 4 hours will normally be sufficient).

B-3. PROCEDURE

B-3.1 Weigh about 25 g of the prepared sample to the nearest 0.001 g and place m a 105 mm diameter porcelain basin. Add a mixture containing 65 ml of water, 7 ml of concentrated nitric acid and 13 ml of concentrated sulphuric acid and heat the contents on a sandbath carefully avoiding; spurting, till all nitric acid is evaporated and fumes of sulphuric acid start rising profusely. Cool, add 90 ml of distilled wafer and 10 ml of concentrated nitric acid and repeat the process until sulphuric acid again starts fuming strongly. Cool and decant the supernatant acid carefully. Add 150 ml of cold distilled water, heat to boiling and decant again. Repeat the cycle of adding distilled water, boiling and decanting carefully till the supernantant liquid is free from sulphuric acid when tested with barium chloride solution. No particle shall be lost in this process. Dry the sample at 110°C to constant mass.

B-4. CALCULATION

B-4.1 Calculate the resistance to acid as follows

$$\text{Resistance to acid, percent by mass} = \frac{M_1}{M} \times 100$$

where

M_1 = final mass in g of the treated sample, and
M = initial mass in g of the sample taken for the test.

APPENDIX C

(*Clause* 5.5)

TEST FOR RESISTANCE TO ARSENICAL ALKALINE SOLUTION

C-0. PRINCIPLE

C-0.1 Ceramic tower packing elements are subjected to reflux boiling for seven days in arsenical alkaline solution contained in stainless steel vessels. On completion of the test, the increment in the silica (as SiO_2), iron (as Fe_2O_3) and aluminium (as Al_2O_3) contents in g/1 in the test solutions is. determined.

C-3.2 Setting Up the Apparatus and Processing the Charge — Charge one of the two stainless steel vessels with 1 000 ml of arsenical alkaline solution (*see* **C-3.1**) and 3 or 4 elements of ceramic tower packings. Similarly, charge the other vessel with arsenical alkaline solution only. Fit the thermometer and reflux condenser on the two vessels, note the date and time of starting the test and put both the vessels for boiling for 7 days.

NOTE — The full test should be carried out as a continuous process but where breaks are unavoidable due to failure of the equipment and difficulties in operating over the week end, the required number of hours should be added on to make up for the time lost

C-3.2.1 After completion of the period of boiling, cool the vessels, remove the ceramic packing elements and allow them to dry by exposure to air. Stir the solutions in the two vessels and transfer quantitatively to two separate volumetric flasks marked with words ' Test Solution ', and ' Blank Solution ' respectively.

NOTE — Should any deposit be observed on the packing elements, it should be gently brushed into the test solution without scrapping any particles other than those of the deposit

C-3.3 Determination of Silica — Stir the test solution and transfer 50 ml to a porcelain dish. Acidify with concentrated hydrochloric acid, boil for 15 minutes and then evaporate to dryness on a sand-bath. Moisten the residue with concentrated hydrochloric acid, bring the residue into solution by agitating with hot water and filter through a filler paper, washing the residue with hot water until free from chloride. Reserve the filtrate.

C-3.3.1 Place the filter paper together with the residue in a tared platinum crucible and gently heat to dry and char the filter paper. Burn off the carbon and ignite the residue at 1 100°C, cool and weigh (M).

C-3.3.2 Moisten the residue with 5 ml of water, add 4 drops of concentrated sulphuric acid followed by 15 ml of hydrofluoric acid. Evaporate the solution slowly to dryness. Ignite at 1 100°C, cool and weigh (M_1) again. Reserve the residue.

G-3.3.3 *Calculation* — Calculate the amount of silica (as SiO_2) as follows:

Silica f as SiO_2) g/1 of the solution $= 20\ (M - M_1)$

where

M = mass in g of silica residue (**C-3.3.1**), and

M_1 = mass in g of the residue after hydrofluorization (**C-3.3.2**).

C-3.4 Determination of Iron — Fuse the residue, if any, in the platinum crucible (*see* **C-3.3.2**) with 2 *g* of anhydrous sodium carbonate and cool. Moist the fused residue in water and a few drops of concentrated hydrochloric acid and transfer the contents by washing with hot water to the beaker containing the filtrate (*see* **C-3.3**).

C-3.4.1 Add 2 drops of concentrated nitric acid to the filtrate (*see* **C-3.4)** and boil to reduce the volume to about 250 ml. Add 2 drops of methyl red indicator followed by 5 g of ammonium chloride and then ammonium hydroxide with constant stirring till the solution turns yellow. Boil for 2 to 5 minutes and filter. Wash the beaker and the precipitate twice with ammonium nitrate solution. Reject the filtrate.

C-3.4.2 Dissolve the precipitate in 5 ml of dilute hydrochloric acid (1 1) and wash with hot water till free from chloride. Make up the volume to about 75 ml, add 20 to 30 ml of sodium hydroxide solution and boil for 10 minutes. Allow the precipitate to coagulate on a water-bath, filter and wash with hot water, Reserve the filtrate.

C-3.4.3 Dissolve the precipitate again in 5 ml of dilute hydrochloric acid (1 . 1) and repeat the procedure given in **C-3.4.2** filtering and washing the precipitate with hot watei till free from chloride. Estimate iron gravimetrically (as Fe_2O_3) by igniting the precipitate.

NOTE — Small amounts of iron may also be estimated by colonmetric or other techniques as may be convement.

C-3.4.4 *Calculation*

Iron (as Fe_2O_3) g/1 of the solution = 20 M

where

M = mass in g of the ignited precipitate.

C-3.5 Determination of Aluminium — Acidify the filtrate reserved in **C-3.4.2** with concentrated hydrochloric acid, add ammonium chloride followed by ammonium hydroxide with constant stirring till the solution turns yellow. Boil for a few minutes till free ammonia odour is expelled. Allow the precipitate to coagulate on a water-bath and filter. Wash with hot ammonium nitrate solution till free from chlende. Transfer the filter paper with precipitate to a tared platinum crucible. Heat gently to dry and finally ignite to a constant mass.

C-3.5.1 *Calculation*

Aluminium (as Al_2O_2) g/1 of the solution = 20 M

where

M = mass in g of the ignited precipitate.

C-3.6 Blank Determination — Carry out the blank determination on 50 ml of the blank solution following the procedure prescribed from **C-3.3** to **C-3.5**.

C-3.7 The material shall be taken as having satisfied the requirement of the test if the resultant values after subtraction for the blank do not exceed the following.

Silica (as SiO_2)	0.30 g/l
Iron (as Fe_2O_3)	traces
Aluminium (as Al_2O_3)	0.57 s/1

APPENDIX D

(*Clause* 5.6)

DETERMINATION OF CRUSHING STRENGTH

D-0. GENERAL

D-0.1 The test is carried out on packings free from defects, such as cracks, indentations or blisters, by subjecting thern to a uniformly increasing axial load till failure is observed.

D-1. APPARATUS

D-1.1 Any suitable compression testing machine provided with self alignmg plattens and capable of exerting an axial load of 20 tonnes and giving readmgs to an accuracy of within 10 kg.

D-2. PREPARATION OF THE SAMPLE

D-2.1 Select samples which are free from such defects as cracks, indentations or blisters. It necessary, grind the ends so that the plane surfaces are perpendicular to the axis of the packing. Do not finish the surface by using chisel or other instrument. Dry the sample.

D-3. PROCEDURE

D-3.1 Place the test piece so that load is applied between the plattens of the compression testing machine as prescribed in **5.6.1** to **5.6.3** using asbestos, millboard of cardboard 2 mm in thickness, and having a diameter greater than that of the packing by at least 10 mm at each end of the test pieces. Apply load steadily and uniformly at a rate not exceeding 10 kg per second till the sample breaks. Note the maximum breaking load.

D-4. CALCULATION

D-4.1 Note the maximum breaking load for each sample and report the mean of the results of at least 10 samples.

NOTE — The values taken for the determination of mean value shall not vary by more than ± 20 percent of the mean value. Values above or below 20 percent of the mean value shall be rejected in the calculation of the mean value

APPENDIX E

(*Clause* 5.7)

DETERMINATION OF TOTAL IRON CONTENT

E-1. APPARATUS

E-1.1 Nessler Cylinder — 50-ml capacity (*see* IS . 4161-1967*).

E-1.2 Platinum Dish — 150-ml capacity.

E-2. REAGENTS

E-2.1 Concentrated Sulphuric Acid — *See* IS 266-1977†.

E-2.2 Hydrofluoric Acid — 40 percent (*m/v*).

E-2.3 Anhydrous Sodium Carbonate — *See* 296-1974‡.

E-2.4 Concentrated Hydrochloric Acid — *See* IS 265-1976§.

E-2.5 Hydrogen Peroxide — 20 percent (*m/v*).

E-2.6 Ammonium Thiocyanate Solution — 50 percent (*m/v*).

E-2.7 Standard Iron Solution — Dissolve 0 49 g of ferrous ammonium, sulphate [$FeSO_4 (NH_4)_2 SO_4.6H_2O$] in water, add 10 ml of dilute sulphuric acid and 5 ml of hydrogen peroxide. Boil for 15 minutes to decompose excess of hydrogen peroxide. Cool and dilute to 1 000 ml. One miliilitre of this solution is equivalent to 0.1 mg of iron (as Fe_2O_3).

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*Specification for Nessler cylinders

†Specification for sulphuric acid (*second revision*)'

‡Specification for sodium carbonate, anhydrous (*second revision*)

§Specification for hydrochloric acid (*second revision*)

E-3. PREPARATION OF THE SAMPLE

E-3.1 Crush the sample in a stoneware mortar to pass through 1.70-mm IS Sieve Quarter the sample, grind in an agate mortar and collect fraction which passes through 250-micron IS Sieve but is retained on 125-micron IS Sieve.

E-4. PROCEDURE

E-4.1 Weigh accurately 1.00 g of the prepared sample in a platinum basin, moisten with 5 ml of water, add 4 drops of concentrated sulphuric acid and 15 ml of hydrofluoric acid. Evaporate slowly on a sand-bath to dryness, Igrite to dull red heat, cool and fuse with 5 g of anhydrous sodium carbonate. Cool and add 10 ml of water followed slowly by 30 ml of concentrated hydrochloric acid. Warm for a few minutes to dissolve the cake and transfer the contents to a 250-ml beaker, rinsing the platinum dish with hot water. Add 5 ml of hydrogen peroxide, boil for 15 minutes and cool Transfer to a 1 000-ml volumetric flask and make up the volume.

E-4.1.1 Transfer 10 ml of the prepared solution (*see* **E-4.1**) to a Nessler cylinder, add 3 ml of ammonium thiocyanate solution and dilute to 50 ml with water. Carry out a control test m the other Nessler cylinder, proceeding as with the material, using a volume of 1.5 ml of the standard iron solution.

E-4.1.2 The material shall be taken as having satisfied the requirements of the test if the intensity of colour produced with the material is not greater than that produced in the control test.

APPENDIX F

(*Clause* 7.1)

SAMPLING AND CRITERIA FOR CONFORMITY FOR CERAMIC TOWER PACKINGS

F-1. SCALE OF SAMPLING

F-1.1 Lot — In any consignment, all ceramic, tower packings of the same type, foini and dimensions manufactured from the same material under relatively similar conditions of manufacture shall be grouped together to constitute a lot.

F-1.2 For ascertaining the conformity of the lot to the requirements of the specification, tests shall be carried out for each lot separately.

F-1.3 The number of ceramic tower packings to be selected from the lot shall depend on the size of the lot and shall be in accordance with Table 4.

TABLE 4 SCALE OF SAMPLING AND PERMISSIBLE NUMBER OF DEFECTIVES

NO. OF CERAMIC TOWER PACKINGS IN THE LOT	STAFF OF SAMPLING	FOR CHARACTERISTICS GIVEN IN CLAUSES 5 2 AND 5.8				FOR CHARACTERISTICS GIVEN IN CLAUSES 5 3, 5 4, 5.5 AND 5 7 & No. OF TESTS FOR EACH CHARACTERISTIC
		No. of Cramic Tower Packing? in the Sample	Cumulative No. of Ceramic Tower Packings in the Sample	Acceptance No	Rejection No.	
(1)	(2)	(1)	(4)	(5)	(6)	(7)
Up to 10 000	First	8	8	0	2	3
	Second	8	16	1	2	
10 001 to 50 000	First	13	13	0	3	3
	Second	13	26	3	4	
50 001 to 100 000	First	20	20	1	4	4
	Second	20	40	4	5	
100 001 and above	First	32	32	2	5	5
	Second	32	64	6	7	

F-1.3.1 For crushing strength, the number of samples to be tested shall be according to col 2 of Table 5.

TABLE 5 SCALE OF SAMPLING AND PERMISSIBLE NUMBER OF DEFECTIVES FOR CRUSHING STRENGTH

NUMBER OF CERAMIC TOWER PACKINGS IN THE LOT	SAMPLE SIZE	ACCEPTANCE NUMBER
(1)	(2)	(3)
Up to 50 000	8	0
50 001 and above	13	1

F-1.3.2 The ceramic tower packings to be included in the sample shall be selected at random from the Jot with the help of random number tables. For necessary guidance, IS : 4905-1968* may be referred,

F.2. NUMBER OF TESTS AND CRITERIA FOR CONFORMTTV

F-2.1 Characteristics Given in 5.2 and 5.8 — In respect of diameter and height, wall thickness, departure from roundness and permissible defects, samples of ceramic tower packings selected according to col 3 of Table 4 shall be examined. A ceramic tower packing failing to satisfy any one or more of these requirements shall be regarded as defective,

F-2.1.1 The lot shall be accepted without further testing if the number of defective ceramic lower packings in the first sample is less than or equal to the corresponding acceptance number given in col 5 of Table 4.

F-2.1.2 The lot shall be rejected without further testing if the number of defective ceramic tower packings is greater than or equal to the corresponding rejection number given m col 6 of Table 4.

F-2.1.3 If the number of defective ceramic tower packings found in the sample is between the corresponding acceptance and rejection numbers, a second sample of the same size, as given in col 3 of Table 4, shall be tested. The lot shall be accepted if the total number of defectives in the first and second samples combined is found to be less than or equal to the corresponding acceptance number given in col 5 of Table 4 and rejected if the number equals or exceeds the corresponding rejection number given in col 6 of Table 4.

F-2.2 Characteristics Given in 5.3 to 5.5 and 5.7 — In respect of water absorption, resistance to acid, resistance *to* arsenical alkaline solution, and total iron content, number of tests for each characteristic shall be carried out as given in col 7 of Table 4. A test sample shall be prepared from sufficient number of ceramic tower packings taken at random from each lot for carrying out a particular test. The lot shall be deemed to have satisfied the requirements if all test samples pass corresponding tests.

F-2.3 Crashing Strength (5.6) — In respect of crushing strength the lot shall be deemed to have satisfied the requirement if the number of samples failing to pass the test is less than or equal to the corresponding acceptance number given in col 3 of Table 5.

F-2.4 The lot shall be accepted if **F-2.1, F-2.2** and **F-2.3** are satisfied.

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*Methods for random sampling.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candels	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 *N*.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	H	1 H = 1 c/s (s^{-1})
Electric conductance	Siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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